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WPI Acc No: 1998-025065/199803

XRAM Acc No: C98-008923

XRPX Acc No: N98-019606

**Semiconductor thin film manufacturing method for TFT - involves forming  
crystalline silicon film by performing dehydrogenation and  
crystallisation to amorphous silicon film**

Patent Assignee: CASIO COMPUTER CO LTD (CASK )

Number of Countries: 001 Number of Patents: 001

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
JP 9283443	A	19971031	JP 96115222	A	19960415	199803 B

Priority Applications (No Type Date): JP 96115222 A 19960415

Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing Notes
JP 9283443	A		5	H01L-021/20	

DIALOG(R)File 347:JAPIO

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MANUFACTURE OF SEMICONDUCTOR THIN FILM

PUB. NO.:        09-283443 [JP 9283443 A]

PUBLISHED:      October 31, 1997 (19971031)

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APPL. NO.:      08-115222 [JP 96115222]

FILED:          April 15, 1996 (19960415)

INTL CLASS:     [6] H01L-021/20; H01L-021/268; H01L-027/12; H01L-029/786;  
                 H01L-021/336

JAPIO CLASS:    42.2 (ELECTRONICS -- Solid State Components)

JAPIO KEYWORD: R002 (LASERS); R004 (PLASMA); R096 (ELECTRONIC MATERIALS --  
                 Glass Conductors)

#### ABSTRACT

PROBLEM TO BE SOLVED: To enable dehydrogenation and crystallization of a hydrogen-containing amorphous silicon thin film in a short period of time.  
SOLUTION: A hydrogen-containing amorphous silicon thin film 25 and a channel protective film forming film 26 made of silicon nitride are continuously deposited on the upper surface of a second gate insulating film 24. Thus, since the amorphous silicon thin film 25 is covered with the channel protective film forming film 26, subsequent dehydrogenation and crystallization processes may be carried out in the atmosphere. By irradiating the amorphous silicon thin film 25 with the light of an excimer lamp in the atmosphere, the amorphous silicon thin film 25 is dehydrogenated. Then, by similarly irradiating the amorphous silicon thin film 25 with an excimer laser in the atmosphere, the amorphous silicon thin film 25 is crystallized, thereby forming a polysilicon thin film 27.

特開平9-283443

(43) 公開日 平成9年(1997)10月31日

(51) Int. Cl. <sup>6</sup>

H01L 21/20

21/268

27/12

29/786

21/336

識別記号

F I

H01L 21/20

21/268

27/12

29/78

Z

R

627

G

審査請求 未請求 請求項の数 5 F D (全5頁)

(21) 出願番号

特願平8-115222

(22) 出願日

平成8年(1996)4月15日

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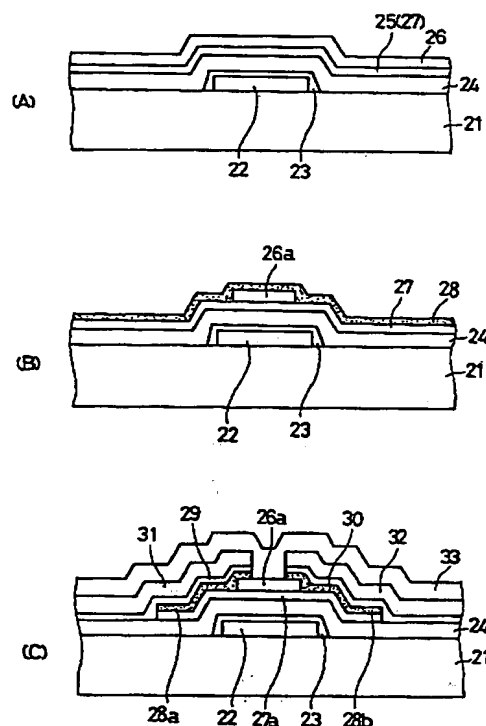
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(54) 【発明の名称】 半導体薄膜の製造方法

(57) 【要約】

【課題】 水素含有のアモルファスシリコン薄膜の脱水素化及び結晶化を短時間で行うことができるようにする。

【解決手段】 第2ゲート絶縁膜24の上面に水素含有のアモルファスシリコン薄膜25および窒化シリコンからなるチャネル保護膜形成用膜26を連続して成膜する。このように、アモルファスシリコン薄膜25をチャネル保護膜形成用膜26で被っているため、後工程の脱水素化工程及び結晶化工程を大気中で行うことが可能となる。そこで、大気中においてエキシマランプの放射光を照射することにより、アモルファスシリコン薄膜25の脱水素化処理を行い、次いで同じく大気中においてエキシマレーザを照射することにより、アモルファスシリコン薄膜25を結晶化してポリシリコン薄膜27を形成する。



## 【特許請求の範囲】

【請求項 1】 水素含有のアモルファス状の半導体薄膜上に絶縁膜を形成し、常圧雰囲気中において前記半導体薄膜にエキシマ光を照射することにより、前記半導体薄膜を脱水素化するとともに前記半導体薄膜の少なくとも一部を結晶化することを特徴とする半導体薄膜の製造方法。

【請求項 2】 請求項 1 記載の発明において、前記常圧雰囲気は大気であることを特徴とする半導体薄膜の製造方法。

【請求項 3】 請求項 1 または 2 記載の発明において、前記半導体薄膜の脱水素化はエキシマランプの照射により行い、前記半導体薄膜の結晶化はエキシマレーザの照射により行うことを特徴とする半導体薄膜の製造方法。

【請求項 4】 請求項 3 記載の発明において、前記エキシマランプを照射し、次いで前記エキシマレーザを照射することを特徴とする半導体薄膜の製造方法。

【請求項 5】 請求項 1 ～ 4 のいずれかに記載の発明において、前記アモルファス状の半導体薄膜はアモルファスシリコン薄膜であることを特徴とする半導体薄膜の製造方法。

## 【発明の詳細な説明】

## 【 0 0 0 1 】

【発明の属する技術分野】 この発明は半導体薄膜の製造方法に関する。

## 【 0 0 0 2 】

【従来の技術】 半導体薄膜の製造方法には、一例として、成膜したアモルファスシリコン薄膜を結晶化してポリシリコン薄膜とする方法がある。そして、結晶化したポリシリコン薄膜によって薄膜トランジスタを形成することがある。図 3 は従来のこのようなポリシリコン薄膜トランジスタの製造工程の一例を示し、図 4 (A) ～

(D) はそれぞれ図 3 に示す製造工程を経て製造されるポリシリコン薄膜トランジスタの各状態における断面図を示したものである。このポリシリコン薄膜トランジスタの製造に際しては、まず図 3 に示すゲート電極形成工程 A において、図 4 (A) に示すように、ガラス基板 1 の上面の所定の個所にゲート電極 2 を形成する。次に、図 3 に示す 2 層連続成膜工程 B において、ゲート電極 2 を含むガラス基板 1 の上面全体にゲート絶縁膜 3 及び水素含有の真性なアモルファスシリコン薄膜 4 を連続して成膜する。次に、図 3 に示す脱水素化工程 C において、後の工程でエキシマレーザ照射により高エネルギーを与えたとき水素が突沸して欠陥が生じるのを避けるために、脱水素化用真空電気炉で熱処理を行うことにより、アモルファスシリコン薄膜 4 中の水素濃度を低減する。

【 0 0 0 3 】 次に、図 3 に示す結晶化工程 D において、真空中においてエキシマレーザを高エネルギー密度で照射することにより、真性なアモルファスシリコン薄膜 4 を結晶化して真性なポリシリコン薄膜 5 を形成する。次

に、図 3 に示す不純物注入工程 E において、図 4 (B) に示すように、ポリシリコン薄膜 5 のうちチャネル領域 5 a となる領域上に不純物注入マスク 6 を形成し、ポリシリコン薄膜 5 のうちチャネル領域 5 a となる領域を除く全領域にリンなどの n 型不純物を注入する。この後、不純物注入マスク 6 を剥離する。次に、図 3 に示す活性化工程 F において、エキシマレーザを低エネルギー密度で照射することにより、n 型不純物注入領域を活性化する。次に、図 3 に示すチャネル保護膜形成工程 G において、図 4 (C) に示すように、ポリシリコン薄膜 5 のうちチャネル領域 5 a となる領域上にチャネル保護膜 7 を形成する。

【 0 0 0 4 】 次に、図 3 に示すデバイスエリア形成工程 H において、図 4 (D) に示すように、ポリシリコン薄膜 5 のうち不要な部分を除去する。この状態では、ポリシリコン薄膜 5 の中央部は真性領域からなるチャネル領域 5 a とされ、その両側は n 型不純物注入領域からなるソース領域 5 b 及びドレイン領域 5 c とされている。次に、図 3 に示すソース・ドレイン電極形成工程 I において、チャネル保護膜 7 の上面両側及びソース領域 5 b、ドレイン領域 5 c の各上面などにソース電極 8 及びドレイン電極 9 を形成する。次に、図 3 に示すオーバーコート膜成膜工程 J において、全上面にオーバーコート膜 10 を成膜する。次に、図 3 に示す水素化工程 K において、水素化用電気炉または水素化用プラズマ炉で水素化処理を行うことにより、ポリシリコン薄膜 5 のダングリングボンドを減少させる。かくして、ボトムゲート型のポリシリコン薄膜トランジスタが製造される。

## 【発明が解決しようとする課題】

【 0 0 0 5 】 ところで、従来のこのようなポリシリコン薄膜トランジスタの製造方法では、図 3 に示す脱水素化工程 C 及び結晶化工程 D を行う際、図 4 (A) に示すように、アモルファスシリコン薄膜 4 が露出しているの、真空中で行っている。このため、脱水素化工程 C 及び結晶化工程 D における真空引きに時間がかかり、スループットが良くないという問題があった。この発明の課題は、脱水素化工程及び結晶化工程を短時間で行うことができるようにすることである。

## 【 0 0 0 6 】

【課題を解決するための手段】 この発明は、水素含有のアモルファス状の半導体薄膜上に絶縁膜を形成し、常圧雰囲気中において前記半導体薄膜にエキシマ光を照射することにより、前記半導体薄膜を脱水素化するとともに前記半導体薄膜の少なくとも一部を結晶化するようにしたものである。

【 0 0 0 7 】 この発明によれば、水素含有のアモルファス状の半導体薄膜上に絶縁膜を形成しているの、半導体薄膜が露出せず、したがって半導体薄膜の脱水素化及び結晶化を常圧雰囲気中において行うことができる。この結果、従来のような真空引きが不要となり、脱水素化

工程及び結晶化工程を短時間で行うことができる。

【0008】

【発明の実施の形態】図1はこの発明の一実施形態を適用したポリシリコン薄膜トランジスタの製造工程を示し、図2(A)～(C)はそれぞれ図1に示す製造工程を経て製造されるポリシリコン薄膜トランジスタの各状態における断面図を示したものである。このポリシリコン薄膜トランジスタの製造に際しては、まず図1に示すゲート電極形成工程Aにおいて、図2(A)に示すように、ガラス基板21の上面の所定の個所にアルミニウム-チタン合金からなるゲート電極22を形成する。次に、図1に示す陽極酸化工程Bにおいて、陽極酸化処理を行うことにより、ゲート電極22の表面に酸化アルミニウムからなる第1ゲート絶縁膜23を形成する。次に、図1に示す3層連続成膜工程Cにおいて、第1ゲート絶縁膜23を含むガラス基板21の上面全体に、P E - C V D により、窒化シリコンからなる第2ゲート絶縁膜24、水素含有の真性なアモルファスシリコン薄膜（半導体薄膜）25及び窒化シリコンからなるチャネル保護膜形成用膜（絶縁膜）26を連続して成膜する。

【0009】次に、図1に示す脱水素化・結晶化工程Dについて説明するが、この場合、水素含有の真性なアモルファスシリコン薄膜25上にチャネル保護膜形成用膜26を成膜しているので、水素含有の真性なアモルファスシリコン薄膜25が露出せず、したがって常圧雰囲気中例えば大気中において行うことが可能となる。そこで、まず大気中においてエキシマランプの放射光（エキシマ光）を照射することにより、水素含有の真性なアモルファスシリコン薄膜25の脱水素化処理を行う。この場合、エキシマランプ照射エリアをガラス基板21を通過させるが、エキシマランプ照射エリアは予備加熱エリアと本加熱エリアとからなっている。予備加熱エリアでは、加熱温度250℃以下での連続照射により、本加熱エリアにおいてゲート電極22及び第1ゲート絶縁膜23中のアルミニウムにヒロックが発生するのを防止するとともに、ガラス基板21の熱ストレスを緩和させる。本加熱エリアでは、ゲート電極22の材料であるアルミニウム-チタン合金の融点以下の高温での連続照射により、水素含有の真性なアモルファスシリコン薄膜25の脱水素化処理を短時間で行う。

【0010】次に、同じく大気中においてエキシマレーザ（エキシマ光）を低エネルギー密度で例えば150mJ/cm<sup>2</sup>程度以下で照射すると、真性なアモルファスシリコン薄膜25が結晶化して真性なポリシリコン薄膜27が形成される。この場合、エキシマレーザのエネルギー密度を150mJ/cm<sup>2</sup>程度以下と低くするのは、特にチャネル保護膜形成用膜26を形成する窒化シリコン膜に水素が含有されているので、この水素が突沸するのを避けるためである。また、エキシマレーザのエネルギー密度が150mJ/cm<sup>2</sup>程度以下と低くても、1μm

程度以下のマイクロクリスタル（結晶化していないものも含む）が形成される。このように、脱水素化工程と結晶化工程とを大気中で連続して行うことができるので、従来のような真空引きが不要となり、脱水素化工程及び結晶化工程を短時間で行うことができ、スループットを良くすることができる。なお、結晶化工程におけるエキシマレーザの照射は、ビームサイズを短い幅を有する細長い帯状とされたレーザビームをビームサイズの幅方向にオーバーラップさせながらスキャン照射することにより行うようにしてもよい。この場合、オーバーラップ量を好ましくは50%以上、より好ましくは90～99%とする。

【0011】次に、図1に示すチャネル保護膜形成工程Eにおいて、図2(B)に示すように、チャネル保護膜形成用膜26のうち不要な部分を除去することにより、ポリシリコン薄膜27上の所定の個所にチャネル保護膜26aを形成する。次に、図1に示すn型シリコン成膜工程Fにおいて、チャネル保護膜26aを含むポリシリコン薄膜27の上面全体にP E - C V D によりリンなどがドーピングされたn型シリコン膜28を成膜する。次に、図1に示すデバイスエリア形成工程Gにおいて、図2(C)に示すように、n型シリコン膜28のうち不要な部分を除去してソース領域28a及びドレイン領域28bを形成するとともに、ポリシリコン薄膜27のうち不要な部分を除去してチャネル領域27aを形成する。すなわち、チャネル保護膜26aの上面両側及びその両側におけるチャネル領域27aの各上面にソース領域28a及びドレイン領域28bを形成する。この場合、チャネル領域27aは真性ポリシリコンからなり、ソース領域28a及びドレイン領域28bはn型シリコンからなっている。このように、ソース領域28a及びドレイン領域28bを、成膜したn型シリコン膜によって形成しているので、不純物注入工程及び活性化工程が不要となり、したがってこれによっても製造工程を簡略化することができる。なお、ソース領域28a及びドレイン領域28bはn型アモルファスシリコンあるいはn型ポリシリコンからなるものであってもよい。

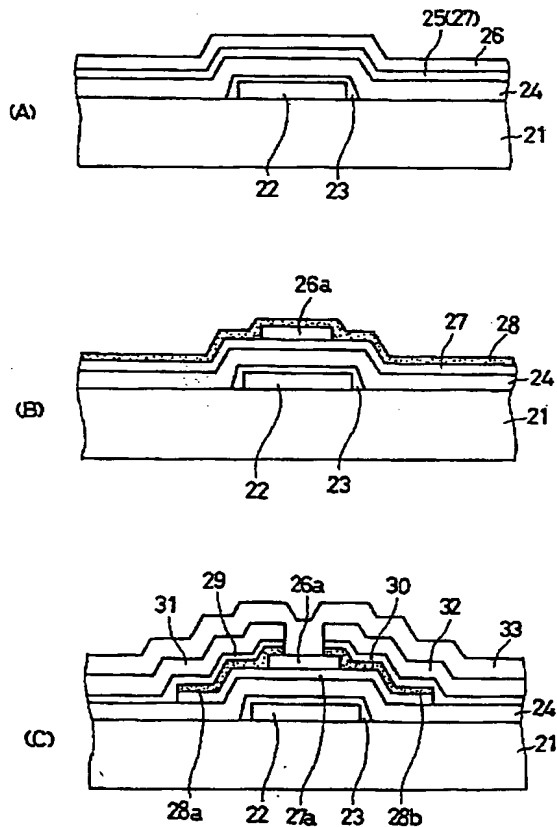
【0012】次に、図1に示すソース・ドレイン電極形成工程Hにおいて、ソース領域28a及びドレイン領域28bの各上面などに、クロムからなる第1ソース電極29及び第1ドレイン電極30を形成し、続いてその各上面にアルミニウム-チタン合金からなる第2ソース電極31及び第2ドレイン電極32を形成する。次に、図1に示すオーバーコート膜成膜工程Iにおいて、全上面にオーバーコート膜33を成膜する。次に、図1に示す水素化工程Jにおいて、水素化用電気炉または水素化用プラズマ炉で水素化処理を行うことにより、チャネル領域27a、ソース領域28a及びドレイン領域28bのダングリングボンドを減少させる。かくして、ボトムゲート型のポリシリコン薄膜トランジスタが製造される。

【0013】ところで、図1に示す製造工程を、従来の同型のつまりボトムゲート型のアモルファスシリコン薄膜トランジスタの製造工程と比較した場合、脱水素化・結晶化工程Dが付加されているだけであるので、従来のボトムゲート型のアモルファスシリコン薄膜トランジスタの製造プロセスラインに脱水素化・結晶化工程Dのためのエキシマランプ装置及びエキシマレーザ装置を付加すると、従来のボトムゲート型のアモルファスシリコン薄膜トランジスタの製造プロセスラインを若干変更してそのまま使用することにより、この発明のポリシリコン薄膜トランジスタを製造することができることになる。なお、この発明は、p型のポリシリコン薄膜トランジスタにも適用することができる。

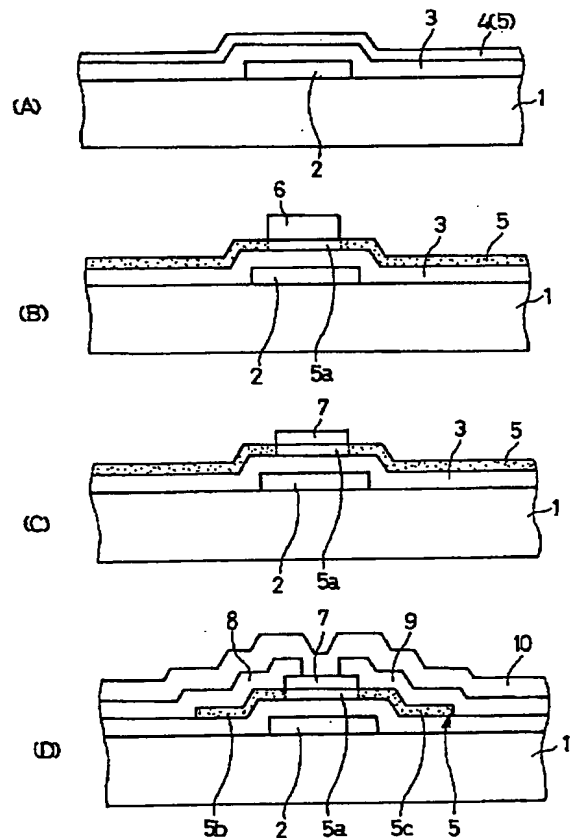
#### 【0014】

【発明の効果】以上説明したように、この発明によれば、アモルファス状の半導体薄膜の脱水素化及び結晶化を常圧雰囲気中において行うことができるので、従来のような真空引きが不要となり、脱水素化工程及び結晶化工程を短時間で行うことができ、スループットを良くすることができる。

【図2】



【図4】



#### 【図面の簡単な説明】

【図1】この発明の一実施形態を適用したポリシリコン薄膜トランジスタの製造工程を示す図。

【図2】(A)～(C)はそれぞれ図1に示す製造工程を経て製造されるポリシリコン薄膜トランジスタの各状態における断面図。

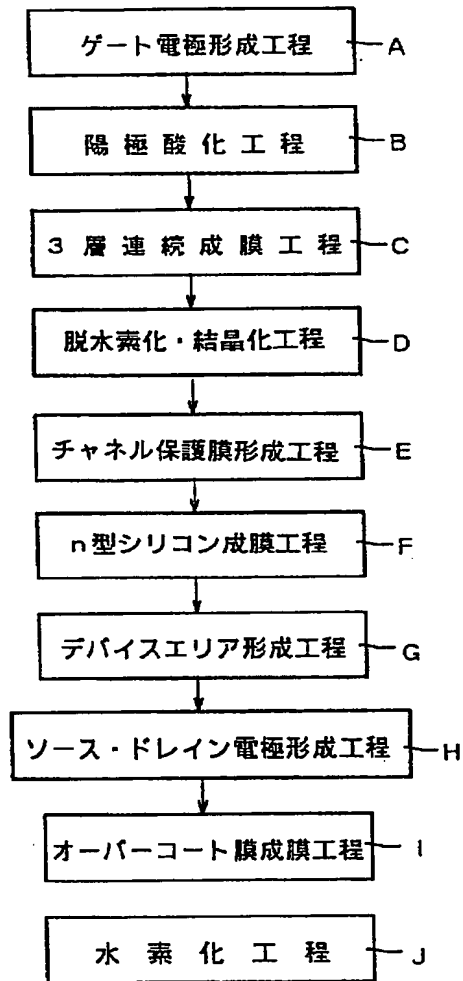
【図3】従来のポリシリコン薄膜トランジスタの製造工程を示す図。

【図4】(A)～(D)はそれぞれ図3に示す製造工程を経て製造されるポリシリコン薄膜トランジスタの各状態における断面図。

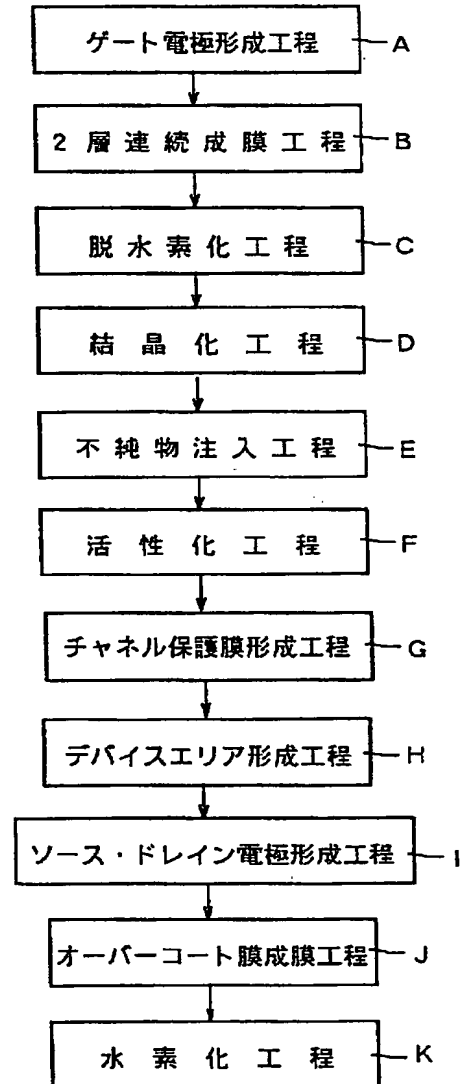
#### 【符号の説明】

- 21 ガラス基板
- 22 ゲート電極
- 23 第1ゲート絶縁膜
- 24 第2ゲート絶縁膜
- 25 アモルファスシリコン薄膜 (半導体薄膜)
- 26 チャンネル保護膜形成用膜 (絶縁膜)
- 27 ポリシリコン薄膜

【図 1】



【図 3】



# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-283443

(43)Date of publication of application : 31.10.1997

(51)Int.Cl.

H01L 21/20  
H01L 21/268  
H01L 27/12  
H01L 29/786  
H01L 21/336

(21)Application number : 08-115222

(71)Applicant : CASIO COMPUT CO LTD

(22)Date of filing : 15.04.1996

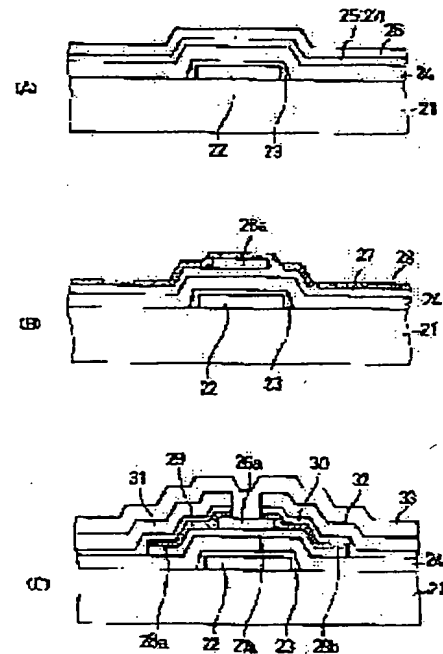
(72)Inventor : KUDO TOSHIO  
WAKAI HARUO

## (54) MANUFACTURE OF SEMICONDUCTOR THIN FILM

### (57)Abstract:

PROBLEM TO BE SOLVED: To enable dehydrogenation and crystallization of a hydrogen-containing amorphous silicon thin film in a short period of time.

SOLUTION: A hydrogen-containing amorphous silicon thin film 25 and a channel protective film forming film 26 made of silicon nitride are continuously deposited on the upper surface of a second gate insulating film 24. Thus, since the amorphous silicon thin film 25 is covered with the channel protective film forming film 26, subsequent dehydrogenation and crystallization processes may be carried out in the atmosphere. By irradiating the amorphous silicon thin film 25 with the light of an excimer lamp in the atmosphere, the amorphous silicon thin film 25 is dehydrogenated. Then, by similarly irradiating the amorphous silicon thin film 25 with an excimer laser in the atmosphere, the amorphous silicon thin film 25 is crystallized, thereby forming a polysilicon thin film 27.



## LEGAL STATUS

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**CLAIMS**

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[Claim]

[Claim 1] The manufacture technique of the semiconductor thin film characterized by crystallizing a part of aforementioned semiconductor thin film [ at least ] while the aforementioned semiconductor thin film is dehydrogenation-ized by forming an insulator layer on the semiconductor thin film of the shape of amorphous [ of hydrogen inclusion ], and irradiating excimer light into the ordinary-pressure ambient atmosphere at the aforementioned semiconductor thin film.

[Claim 2] It is the manufacture technique of the semiconductor thin film characterized by the aforementioned ordinary-pressure ambient atmosphere being the atmospheric air in invention of claim 1 publication.

[Claim 3] It is the manufacture technique of the semiconductor thin film characterized by for irradiation of an excimer lamp performing dehydrogenation-ization of the aforementioned semiconductor thin film, and performing crystallization of the aforementioned semiconductor thin film by irradiation of an excimer laser in invention the claim 1 or given in two.

[Claim 4] The manufacture technique of the semiconductor thin film characterized by irradiating the aforementioned excimer lamp and subsequently irradiating the aforementioned excimer laser in invention of claim 3 publication.

[Claim 5] It is the manufacture technique of the semiconductor thin film characterized by the semiconductor thin film of the shape of amorphous [ aforementioned ] being an amorphous silicon thin film in invention given in either of the claims 1-4.

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DETAILED DESCRIPTION

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[Detailed description]

[0001]

[The technical field to which invention belongs] This invention relates to the manufacture technique of a semiconductor thin film.

[0002]

[Prior art] There is the technique of crystallizing the amorphous silicon thin film which \*\*\*\*ed and making it into a polysilicon contest thin film as an example, among the manufacture technique of a semiconductor thin film. And TFT may be formed by the crystallized polysilicon contest thin film. Drawing 3 shows an example of the manufacturing process of such conventional polysilicon contest TFT, and drawing 4 (A) - (D) shows the cross section in each status of the polysilicon contest TFT manufactured through the manufacturing process shown in drawing 3, respectively. In case of a manufacture of this polysilicon contest TFT, in gate electrode formation process A first shown in drawing 3, as shown in drawing 4 (A), the gate electrode 2 is formed in the predetermined part of the top of a glass substrate 1. Next, in two-layer continuity \*\*\*\* process B shown in drawing 3, the gate insulator layer 3 and the genuineness hydrogen inclusion amorphous silicon thin film 4 are continued and \*\*\*\*ed on the whole top of the glass substrate 1 containing the gate electrode 2. Next, in dehydrogenation-ized process C shown in drawing 3, when a high energy is given by excimer laser irradiation at a next process, in order to avoid that hydrogen bumps and a defect arises, the hydrogen concentration in the amorphous silicon thin film 4 is reduced by heat-treating with the vacuum electric furnace for dehydrogenation-izing.

[0003] Next, in crystallization process D shown in drawing 3, by irradiating an excimer laser by the high-energy density into a vacuum, the genuineness amorphous silicon thin film 4 is crystallized, and the genuineness polysilicon contest thin film 5 is formed. Next, in impurity injection process E shown in drawing 3, as shown in drawing 4 (B), the impurity injection mask 6 is formed on the field which serves as channel field 5a among the polysilicon contest thin films 5, and n type impurities, such as Lynn, are poured into all the fields except the field which serves as channel field 5a among the polysilicon contest thin films 5. Then, the impurity injection mask 6 is exfoliated. Next, in activation process F shown in drawing 3, n type impurity injection field is activated by irradiating an excimer laser by the low-energy density. Next, in channel protective coat formation process G shown in drawing 3, as shown in drawing 4 (C), the channel protective coat 7 is formed on the field which serves as channel field 5a among the polysilicon contest thin films 5.

[0004] Next, in device area formation process H shown in drawing 3, as shown in drawing 4 (D), an unnecessary fraction is removed among the polysilicon contest thin films 5. In this status, the center section of the polysilicon contest thin film 5 is set to channel field 5a which consists of an intrinsic region, and the both sides are set to source field 5b and drain field 5c which consist of an n type impurity injection field. Next, in source drain electrode formation process I shown in drawing 3, the source electrode 8 and the drain electrode 9 are formed in each top of the top both sides of the channel protective coat 7 and source field 5b, and drain field 5c etc. Next, in overcoat \*\*\*\*\* process J shown in

drawing 3 , the overcoat layer 10 is \*\*\*\*ed on all the top. Next, in hydrogenation process K shown in drawing 3 , the dangling bond of the polysilicon contest thin film 5 is decreased by performing a hydrogen treating by the electric furnace for hydrogenation, or the plasma furnace for hydrogenation. In this way, bottom gate type polysilicon contest TFT is manufactured.

[Object of the Invention]

[0005] By the way, by the manufacture technique of such conventional polysilicon contest TFT, since the amorphous silicon thin film 4 is exposed as shown in drawing 4 (A) in case dehydrogenation-ized process C and crystallization process D which are shown in drawing 3 are performed, it is carrying out in the vacuum. For this reason, the vacuum length in dehydrogenation-ized process C and crystallization process D took time, and there was a problem that a throughput was not good. The technical problem of this invention is enabling it to perform a dehydrogenation-ized process and a crystallization process for a short time.

[0006]

[The means for solving a technical problem] This invention forms an insulator layer on the semiconductor thin film of the shape of amorphous [ of hydrogen inclusion ], and by irradiating excimer light into the ordinary-pressure ambient atmosphere at the aforementioned semiconductor thin film, it crystallizes a part of aforementioned semiconductor thin film [ at least ] while it dehydrogenation-izes the aforementioned semiconductor thin film.

[0007] According to this invention, since the insulator layer is formed on the semiconductor thin film of the shape of amorphous [ of hydrogen inclusion ], a semiconductor thin film cannot be exposed, therefore dehydrogenation-izing and crystallization of a semiconductor thin film can be performed into the ordinary-pressure ambient atmosphere. Consequently, vacuum length like before becomes unnecessary and a dehydrogenation-ized process and a crystallization process can be performed for a short time.

[0008]

[Gestalt of implementation of invention] Drawing 1 shows the manufacturing process of the polysilicon contest TFT which applied the 1 enforcement gestalt of this invention, and drawing 2 (A) - (C) shows the cross section in each status of the polysilicon contest TFT manufactured through the manufacturing process shown in drawing 1 , respectively. In case of a manufacture of this polysilicon contest TFT, as gate electrode formation process A first shown in drawing 1 is shown in drawing 2 (A), the gate electrode 22 which consists of an aluminum-titanium alloy is formed in the predetermined part of the top of a glass substrate 21. Next, in anodic oxidation process B shown in drawing 1 , the 1st gate insulator layer 23 which consists of an aluminum oxide is formed in the front face of the gate electrode 22 by performing an anodizing. Next, in three layer continuity \*\*\*\* process C shown in drawing 1 , the layer (insulator layer) for channel protective coat formation 26 which consists of the 2nd gate insulator layer 24, the genuineness hydrogen inclusion amorphous silicon thin film (semiconductor thin film) 25, and silicon nitride which consist of a silicon nitride is continuously \*\*\*\*ed by PE-CVD on the whole top of the glass substrate 21 containing the 1st gate insulator layer 23.

[0009] Next, although dehydrogenation-izing and crystallization process D shown in drawing 1 are explained, since the layer for channel protective coat formation 26 is \*\*\*\*ed on the genuineness hydrogen inclusion amorphous silicon thin film 25 in this case, it is enabled for the genuineness hydrogen inclusion amorphous silicon thin film 25 not to be exposed, therefore to carry out into the ordinary-pressure ambient atmosphere, for example, the atmospheric air. Then, dehydrogenation-ized processing of the genuineness hydrogen inclusion amorphous silicon thin film 25 is performed by irradiating the synchrotron orbital radiation (excimer light) of an excimer-lamp into the atmospheric air first. In this case, although a glass substrate 21 is passed, the excimer lamp irradiation area consists the excimer lamp irradiation area of a preheating area and this heating area. While it prevents that reach gate electrode 22 in this heating area, and a hillock occurs to the aluminum in the 1st gate insulator layer 23 by the continuous irradiation with a heating temperature of 250 degrees C or less, the heat stress of a glass substrate 21 is made to ease in a preheating area. In this heating area, the continuous irradiation in the elevated temperature below the melting point of the aluminum-titanium alloy which is the material

of the gate electrode 22 performs dehydrogenation-ized processing of the genuineness hydrogen inclusion amorphous silicon thin film 25 for a short time.

[0010] Next, if it is 2 or less-about 150mJ/cm and an excimer laser (excimer light) is similarly irradiated by the low-energy density into the atmospheric air, the genuineness amorphous silicon thin film 25 will crystallize, and the genuineness polysilicon contest thin film 27 will be formed. In this case, since hydrogen contains in the silicon nitride film which forms the layer for channel protective coat formation 26, it is for avoiding that this hydrogen bumps especially to make the energy density of an excimer laser low with 2 or less-about 150mJ/cm. Moreover, even if the energy density of an excimer laser is as low as 2 or less-about 150mJ/cm, micro crystal (what is not being crystallized is included) about 1 micrometer or less is formed. Thus, since a dehydrogenation-ized process and a crystallization process can be continuously performed in the atmospheric air, vacuum length like before can become unnecessary, can perform a dehydrogenation-ized process and a crystallization process for a short time, and can improve a throughput. In addition, you may be made to perform irradiation of the excimer laser in a crystallization process by carrying out scanning irradiation, making the long and slender laser beam which has short width of face for a beam size and which was made beltlike overlap crosswise [ of a beam size ]. In this case, the amount of overlap is more preferably made into 90 - 99% 50% or more.

[0011] Next, in channel protective coat formation process E shown in drawing 1 , as shown in drawing 2 (B), channel protective coat 26a is formed in the predetermined part on the polysilicon contest thin film 27 by removing an unnecessary fraction among the layers for channel protective coat formation 26.

Next, in n type silicon \*\*\*\* process F shown in drawing 1 , n type silicon layer 28 by which Lynn etc. was doped by the whole top of the polysilicon contest thin film 27 containing channel protective coat 26a by PE-CVD is \*\*\*\*ed. Next, in device area formation process G shown in drawing 1 , as shown in drawing 2 (C), while an unnecessary fraction is removed among n type silicon layers 28 and source field 28a and drain field 28b are formed, an unnecessary fraction is removed among the polysilicon contest thin films 27, and channel field 27a is formed. That is, source field 28a and drain field 28b are formed in the top both sides of channel protective coat 26a, and each top of channel field 27a in the both sides. In this case, channel field 27a consists of contest intrinsic polysilicon, and source field 28a and drain field 28b consist of n type silicon. Thus, since source field 28a and drain field 28b are formed with n type silicon layer which \*\*\*\*ed, an impurity injection process and an activation process become unnecessary, therefore a manufacturing process can be simplified also by this. In addition, source field 28a and drain field 28b may consist of an n type amorphous silicon or contest n type polysilicon.

[0012] the [ next, / the 1st source electrode 29 which becomes each top of source field 28a and drain field 28b etc. from chromium in source drain electrode formation process H shown in drawing 1 , and ] - the [ the 2nd source electrode 31 which forms 1 drain electrode 30, and becomes each of that top from an aluminum-titanium alloy continuously, and ] - 2 drain electrode 32 is formed Next, in overcoat \*\*\*\*\* process I shown in drawing 1 , the overcoat layer 33 is \*\*\*\*ed on all the top. Next, in hydrogenation process J shown in drawing 1 , the dangling bond of channel field 27a, source field 28a, and drain field 28b is decreased by performing a hydrogen treating by the electric furnace for hydrogenation, or the plasma furnace for hydrogenation. In this way, bottom gate type polysilicon contest TFT is manufactured.

[0013] by the way, when [ with the former of the same type ] it is got blocked and it compares with the manufacturing process of bottom gate type amorphous silicon TFT, the manufacturing process shown in drawing 1 [ only being added to dehydrogenation-izing and crystallization process D, and ] If the excimer lamp equipment and excimer laser equipment for dehydrogenation-izing and crystallization process D are added to the manufacture process line of conventional bottom gate type amorphous silicon TFT The polysilicon contest TFT of this invention can be manufactured by changing the manufacture process line of conventional bottom gate type amorphous silicon TFT a little, and using it as it is. In addition, this invention is applicable also to p type polysilicon contest TFT.

[0014]

[Effect of the invention] Since dehydrogenation-izing and crystallization of the shape of amorphous of a semiconductor thin film can be performed into the ordinary-pressure ambient atmosphere according to

this invention as explained above, vacuum length like before can become unnecessary, can perform a dehydrogenation-ized process and a crystallization process for a short time, and can improve a throughput.

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**TECHNICAL FIELD**

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[The technical field to which invention belongs] This invention relates to the manufacture technique of a semiconductor thin film.

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PRIOR ART

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[Prior art] There is the technique of crystallizing the amorphous silicon thin film which \*\*\*\*ed and making it into a polysilicon contest thin film as an example, among the manufacture technique of a semiconductor thin film. And TFT may be formed by the crystallized polysilicon contest thin film. Drawing 3 shows an example of the manufacturing process of such conventional polysilicon contest TFT, and drawing 4 (A) - (D) shows the cross section in each status of the polysilicon contest TFT manufactured through the manufacturing process shown in drawing 3, respectively. In case of a manufacture of this polysilicon contest TFT, in gate electrode formation process A first shown in drawing 3, as shown in drawing 4 (A), the gate electrode 2 is formed in the predetermined part of the top of a glass substrate 1. Next, in two-layer continuity \*\*\*\* process B shown in drawing 3, the gate insulator layer 3 and the genuineness hydrogen inclusion amorphous silicon thin film 4 are continued and \*\*\*\*ed on the whole top of the glass substrate 1 containing the gate electrode 2. Next, in dehydrogenation-ized process C shown in drawing 3, when a high energy is given by excimer laser irradiation at a next process, in order to avoid that hydrogen bumps and a defect arises, the hydrogen concentration in the amorphous silicon thin film 4 is reduced by heat-treating with the vacuum electric furnace for dehydrogenation-izing.

[0003] Next, in crystallization process D shown in drawing 3, by irradiating an excimer laser by the high-energy density into a vacuum, the genuineness amorphous silicon thin film 4 is crystallized, and the genuineness polysilicon contest thin film 5 is formed. Next, in impurity injection process E shown in drawing 3, as shown in drawing 4 (B), the impurity injection mask 6 is formed on the field which serves as channel field 5a among the polysilicon contest thin films 5, and n type impurities, such as Lynn, are poured into all the fields except the field which serves as channel field 5a among the polysilicon contest thin films 5. Then, the impurity injection mask 6 is exfoliated. Next, in activation process F shown in drawing 3, n type impurity injection field is activated by irradiating an excimer laser by the low-energy density. Next, in channel protective coat formation process G shown in drawing 3, as shown in drawing 4 (C), the channel protective coat 7 is formed on the field which serves as channel field 5a among the polysilicon contest thin films 5.

[0004] Next, in device area formation process H shown in drawing 3, as shown in drawing 4 (D), an unnecessary fraction is removed among the polysilicon contest thin films 5. In this status, the center section of the polysilicon contest thin film 5 is set to channel field 5a which consists of an intrinsic region, and the both sides are set to source field 5b and drain field 5c which consist of an n type impurity injection field. Next, in source drain electrode formation process I shown in drawing 3, the source electrode 8 and the drain electrode 9 are formed in each top of the top both sides of the channel protective coat 7 and source field 5b, and drain field 5c etc. Next, in overcoat \*\*\*\*\* process J shown in drawing 3, the overcoat layer 10 is \*\*\*\*ed on all the top. Next, in hydrogenation process K shown in drawing 3, the dangling bond of the polysilicon contest thin film 5 is decreased by performing a hydrogen treating by the electric furnace for hydrogenation, or the plasma furnace for hydrogenation. In this way, bottom gate type polysilicon contest TFT is manufactured.



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**EFFECT OF THE INVENTION**

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[Effect of the invention] Since dehydrogenation-izing and crystallization of the shape of amorphous of a semiconductor thin film can be performed into the ordinary-pressure ambient atmosphere according to this invention as explained above, vacuum length like before can become unnecessary, can perform a dehydrogenation-ized process and a crystallization process for a short time, and can improve a throughput.

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